CLAIMS

What is claimed is:

1. A drive-by-wire riding lawn mower, the mower comprising:

at least two independently driven wheels capable of bi-directional rotation, the at least two wheels being independently driven so that operation of the at least two wheels causes the at least two wheels to independently rotate which propels and steers the mower;

a microprocessor, the microprocessor controlling the operation of the at least two wheels in accordance with signals received by the microprocessor; and

at least one controller, the at least one controller sending signals to the microprocessor that the microprocessor uses to control the operation of the at least two wheels so that operation of the at least one controller causes the at least two wheels to propel and steer the mower.

2. The mower of claim 1, wherein the at least two wheels are hydraulically driven and further comprising:

at least one hydraulic pump that provides a flow of hydraulic fluid to drive the at least two wheels.

3. The mower of claim 2, further comprising:

at least one proportional servo valve that controls a direction and speed of the flow of hydraulic fluid to the at least two wheels, the at least one valve being controlled by the microprocessor and adjusting the flow of hydraulic fluid to the at least two wheels in response to signals received from the microprocessor, the adjusting of the flow of hydraulic fluid by the at least one valve controlling the direction and speed of rotation of the at least two wheels so that the mower can be propelled and steered.

4. The mower of claim 3, wherein:

the at least one hydraulic pump is one of a plurality of hydraulic pumps;

a first hydraulic pump of the plurality of hydraulic pumps provides a flow of hydraulic fluid to a first wheel of the at least two wheels;

a second hydraulic pump of the plurality of hydraulic pumps provides a flow of hydraulic fluid to a second wheel of the at least two wheels;

the at least one proportional servo valve is one of a plurality of proportional servo valves;

a first valve of the plurality of valves adjusting the flow of hydraulic fluid from the first hydraulic pump of the plurality of hydraulic pumps to the first wheel of the at least two wheels in response to signals received from the microprocessor; and

a second valve of the plurality of valves adjusting the flow of hydraulic fluid from the second hydraulic pump of the plurality of hydraulic pumps to the second wheel of the at least two wheels in response to signals received from the microprocessor.

5. The mower of claim 1, wherein the at least one controller further comprises:

a first controller that sends signals to the microprocessor that the microprocessor uses to control the operation of a first wheel of the at least two wheels so that operation of the first controller causes the first wheel of the at least two wheels to rotate; and

a second controller that sends signals to the microprocessor that the microprocessor uses to control the operation of a second wheel of the at least two wheels so that operation of the second controller causes the second wheel of the at least two wheels to rotate.

6. The mower of claim 5, wherein:

the first and second controllers are each selectively moveable between forward and reverse positions;

movement of the first controller toward the forward position causing the first wheel of the at least two wheels to rotate in a direction that corresponds to propelling the mower in a forward direction and movement of the first controller toward the reverse position causing the first wheel of the at least two wheels to rotate in a direction that corresponds to propelling the mower in a backward direction; and

movement of the second controller toward the forward position causing the second wheel of the at least two wheels to rotate in a direction that corresponds to propelling the mower in a forward direction and movement of the second controller toward the reverse position causing the second wheel of the at least two wheels to rotate in a direction that corresponds to propelling the mower in a backward direction.

7. The mower of claim 6, wherein:

each controller has a neutral position disposed between the forward and reverse positions;

positioning of the first controller in the neutral position causing the first wheel of the at least two wheels to not be driven; and

positioning of the second controller in the neutral position causing the second wheel of the at least two wheels to not be driven.

8. The mower of claim 7, wherein:

the first and second controllers are each biased to the neutral positions so that the first and second controllers return to the neutral positions when no force is being applied to the first and second controllers.

9. The mower of claim 7, wherein:

movement of the first and second controllers from the neutral position toward the forward and reverse positions causes a speed of rotation of the respective first and second wheels of the at least two wheels to increase in proportion to the movement of the first and second controllers from the neutral position.

10. The mower of claim 9, wherein:

the proportional increase in the speed of rotation of the at least two wheels in response to movement of the first and second controllers from the neutral positions toward the forward positions is greater than the proportional increase in the speed of rotation of the at least two wheels in response to movement of the first and second controllers from the neutral positions toward the reverse positions so that the mower is capable of being propelled faster in the forward direction than in the backward direction.

11. The mower of claim 1, wherein the at least one controller further comprises:

a first controller that sends signals to the microprocessor that the microprocessor uses to control the operation of the at least two wheels, the signals from the first controller informing the microprocessor of whether the mower is to be propelled in a forward or backward direction; and

a second controller that sends signals to the microprocessor that the microprocessor uses to control the operation of the at least two wheels, the signals from the second controller informing the microprocessor of a direction in which the mower is to be steered.

12. The mower of claim 11, wherein:

the first controller is selectively moveable between forward and reverse positions;

movement of the first controller toward the forward position causing the at least two wheels to rotate in a direction that corresponds to propelling the mower in a forward direction and movement of the first controller toward the reverse position causing the at least two wheels to rotate in a direction that corresponds to propelling the mower in a backward direction;

the second controller is selectively moveable between left and right positions; and

movement of the second controller toward the left position causing the at least two wheels to rotate at different rates so that the mower turns to the left and movement of the second controller toward the right position causing the at least two wheels to rotate at different rates so that the mower turns to the right.

13. The mower of claim 12, wherein:

the first controller has a neutral position disposed between the forward and reverse positions; and

positioning of the first controller in the neutral position causes the at least two wheels to not be driven.

14. The mower of claim 13, wherein:

the first controller is biased to the neutral position so that the first controller is positioned in the neutral position when no force is being applied to the first controller.

15. The mower of claim 13, wherein:

movement of the first controller from the neutral position toward the forward and reverse positions causes a speed of rotation of the at least two wheels to increase in proportion to the movement of the first controller from the neutral position.

16. The mower of claim 15, wherein:

the proportional increase in the speed of rotation of the at least two wheels in response to movement of the first controller from the neutral position toward the forward position is greater than the proportional increase in the speed of rotation of the at least two wheels in response to movement of the first controller from the neutral position toward the reverse position so that the mower is capable of being propelled faster in the forward direction than in the backward direction.

17. The mower of claim 13, wherein:

the first controller is a joystick that moves linearly between the forward and reverse positions.

18. The mower of claim 13, wherein:

the first controller is a foot pedal that rotates about an axis between the forward and reverse positions.

19. The mower of claim 12, wherein:

the second controller has a neutral position disposed between the left and right positions; and

positioning of the second controller in the neutral position causes the second controller to not effect a rate at which each of the at least two wheels rotate.

20. The mower of claim 19, wherein:

the second controller is biased to the neutral position so that the second controller is positioned in the neutral position when no force is being applied to the second controller.

21. The mower of claim 19, wherein:

movement of the second controller from the neutral position toward the left and right positions causes the difference in the rate of rotation of the at least two wheels to increase in proportion to the movement of the second controller from the neutral position.

22. The mower of claim 19, wherein:

the second controller is selectively moveable between extreme left and extreme right positions, the extreme left and extreme right positions being disposed beyond the respective left and right positions so that the second controller must move past the left and right positions to reach the respective extreme left and extreme right positions; and

movement of the second controller past the left position toward the extreme left position causes the mower to counter steer left and movement of the second controller past the right position toward the extreme right position causes the mower to counter steer right.

23. The mower of claim 22, wherein:

movement of the second controller past the left and right positions toward the respective extreme left and extreme right positions causes a speed of the counter steer to increase in proportion to the movement past the left and right positions.

24. The mower of claim 22, wherein:

movement of the second controller past the left and right positions toward the respective extreme left and extreme right positions provides a tactile sensation so that an operator of the mower will feel the tactile sensation prior to the mower counter steering.

25. The mower of claim 22, wherein:

the second controller is a steering wheel that rotates; and

rotation of the steering wheel causes the second controller to move between the extreme left and extreme right positions.

26. The mower of claim 22, wherein:

the second controller is a joystick that moves linearly between the extreme left and extreme right positions.

27. The mower of claim 1, further comprising:

a biasing switch, the biasing switch being selectively operable to adjust the operation of the at least two wheels so that the mower can track a desired path, the biasing switch sending signals to the microprocessor in response to operation of the biasing switch that the microprocessor uses to control the operation of the at least two wheels.

28. The mower of claim 1, further comprising:

a mode switch, the mode switch being selectively operable between a work position and a transport position to adjust the operation of the at least two wheels, the work position corresponding to normal operation of the mower and the transport position corresponding to high speed operation of the mower, and the mode switch sending a signal to the microprocessor that the microprocessor uses to control the operation of the at least two wheels; and

the microprocessor operating the mower in a normal mode when the mode switch is in the work position and reducing a rate at which the at least two wheels steer the mower when the mode switch is in the transport mode so that the mower can safely turn during high speed operation.

29. The mower of claim 1, further comprising:

a gain controller that is selectively operable, the gain controller allowing a user of the mower to adjust the response of the mower caused by operation of the at least one controller, and operation of the gain controller causing the gain controller to send signals to the microprocessor that inform the microprocessor on how to interpret signals from the at least one controller; and

the microprocessor adjusts the operation of the at least two wheels in response to signals received by the microprocessor from the at least one controller based upon signals received from the gain controller.

30. A drive-by-wire dual path hydraulically driven riding lawn mower, the mower comprising:

first and second hydraulic pumps, the first and second hydraulic pumps providing respective first and second flows of hydraulic fluid;

first and second hydraulically driven wheels that operate independently and are capable of bi-directional rotation, the first and second wheels being independently rotated by the respective first and second flows of hydraulic fluid, and the independent rotation of the first and second wheels propelling and steering the mower;

a microprocessor, the microprocessor controlling the operation of the first and second wheels by controlling the first and second flows of hydraulic fluid to the respective first and second wheels in accordance with signals received by the microprocessor; and

at least one controller, the at least one controller sending signals to the microprocessor that the microprocessor uses to control the operation of the first and second wheels so that operation of the at least one controller causes the first and second wheels to propel and steer the mower.

31. The mower of claim 30, further comprising:

first and second proportional servo valves, the first and second valves controlling a direction and volume of flow of the respective first and second flows of hydraulic fluid in response to signals received from the microprocessor, the controlling of the direction and volume of flow of the first and second flows of hydraulic fluid controlling a direction and speed of rotation of the respective first and second wheels.

32. The mower of claim 31, wherein:

the at least one controller is a joystick that is capable of movement in two dimensions and movement of the joystick in the two dimensions sending signals to the microprocessor that the microprocessor uses to control the operation of the first and second wheels.

33. The mower of claim 31, wherein the at least one controller further comprises:

a first controller that sends signals to the microprocessor that the microprocessor uses to control to the operation of first wheel; and

a second controller that sends signals to the microprocessor that the microprocessor uses to control the operation of the second wheel.

34. The mower of claim 33, wherein:

the first and second controllers are each selectively moveable between forward and reverse positions;

movement of the first controller toward the forward position causing the first wheel to rotate in a direction that corresponds to propelling the mower in a forward direction and movement of the first controller toward the reverse position causing the first wheel to rotate in a direction that corresponds to propelling the mower in a backward direction; and

movement of the second controller toward the forward position causing the second wheel to rotate in a direction that corresponds to propelling the mower in a forward direction and movement of the second controller toward the reverse position causing the second wheel to rotate in a direction that corresponds to propelling the mower in a backward direction.

35. The mower of claim 34, wherein:

the first and second controllers each have a neutral position disposed between the forward and reverse positions;

positioning of the first controller in the neutral position causing the first wheel to not be driven; and

positioning of the second controller in the neutral position causing the second wheel to not be driven.

36. The mower of claim 35, wherein:

the first and second controllers are each biased to the neutral positions so that the first and second controllers return to the neutral positions when no force is being applied to the first and second controllers.

37. The mower of claim 35, wherein:

movement of the first and second controllers from the neutral positions toward the forward and reverse positions causes the speed of rotation of the respective first and second wheels to increase in proportion to the movement of the first and second controllers from the neutral position.

38. The mower of claim 37, wherein:

the proportional increase in the speed of rotation of the first and second wheels in response to movement of the respective first and second controllers from the neutral positions toward the forward positions is greater than the proportional increase in the speed of rotation of the first and second wheels in response to movement of the respective first and second controllers from the neutral positions toward the reverse positions so that the mower is capable of being propelled faster in the forward direction than in the backward direction.

39. The mower of claim 31, wherein the at least one controller further comprises:

a first controller that sends signals to the microprocessor that the microprocessor uses to control the operation of the first and second wheels, the signals from the first controller informing the microprocessor of whether the mower is to be propelled in a forward or backward direction; and

a second controller that sends signals to the microprocessor that the microprocessor uses to control the operation of the first and second wheels, the signals from the second controller informing the microprocessor of a direction in which the mower is to be steered.

40. The mower of claim 39, wherein:

the first controller is selectively moveable between forward and reverse positions;

movement of the first controller toward the forward position causing the first and second wheels to rotate in a direction that corresponds to propelling the mower in a forward direction and movement of the first controller toward the reverse position causing the first and second wheels to rotate in a direction that corresponds to propelling the mower in a backward direction;

the second controller is selectively moveable between left and right positions; and

movement of the second controller toward the left position causing the first and second wheels to rotate at different speeds so that the mower turns to the left and movement of the second controller toward the right position causing the first and second wheels to rotate at different speeds so that the mower turns to the right.

41. The mower of claim 40, wherein:

the first controller has a neutral position disposed between the forward and reverse positions; and

positioning of the first controller in the neutral position causes the first and second wheels to not be driven.

42. The mower of claim 41, wherein:

the first controller is biased to the neutral position so that the first controller is positioned in the neutral position when no force is being applied to the first controller.

43. The mower of claim 41, wherein:

movement of the first controller from the neutral position toward the forward and reverse positions causes the speed of rotation of the first and second wheels to increase in proportion to the movement of the first controller from the neutral position.

44. The mower of claim 43, wherein:

the proportional increase in the speed of rotation of the first and second wheels in response to movement of the first controller from the neutral position toward the forward position is greater than the proportional increase in the speed of rotation of the first and second wheels in response to movement of the first controller from the neutral position toward the reverse position so that the mower is capable of being propelled faster in the forward direction than in the backward direction.

45. The mower of claim 41, wherein:

the first controller is a joystick that moves linearly between the forward and reverse positions.

46. The mower of claim 41, wherein:

the first controller is a foot pedal that rotates about an axis between the forward and reverse positions.

47. The mower of claim 40, wherein:

the second controller has a neutral position disposed between the left and right positions; and

positioning of the second controller in the neutral position causes the second controller to not effect the speed at which each of the first and second wheels rotate.

48. The mower of claim 47, wherein:

the second controller is biased to the neutral position so that the second controller is positioned in the neutral position when no force is being applied to the second controller.

49. The mower of claim 47, wherein:

movement of the second controller from the neutral position toward the left and right positions causes a difference in the speed of rotation of the first and second wheels to increase in proportion to the movement of the second controller from the neutral position.

50. The mower of claim 47, wherein:

the second controller is selectively moveable between extreme left and extreme right positions, the extreme left and extreme right positions being disposed beyond the respective left and right positions so that the second controller must move past the left and right positions to reach the respective extreme left and extreme right positions; and

movement of the second controller past the left position toward the extreme left position causes the mower to counter steer left and movement of the second controller past the right position toward the extreme right position causes the mower to counter steer right.

51. The mower of claim 50, wherein:

movement of the second controller past the left and right positions toward the respective extreme left and extreme right positions causes a speed of the counter steer to increase in proportion to the movement of the second controller past the left and right positions.

52. The mower of claim 50, wherein:

movement of the second controller past the left and right positions toward the respective extreme left and extreme right positions provides a tactile sensation so that an operator of the mower will feel the tactile sensation prior to the mower counter steering.

53. The mower of claim 50, wherein:

the second controller is a steering wheel that rotates; and

rotation of the steering wheel causes the second controller to move between the extreme left and extreme right positions.

54. The mower of claim 50, wherein:

the second controller is a joystick that moves linearly between the extreme left and extreme right positions.

55. The mower of claim 31, further comprising:

a biasing switch, the biasing switch being selectively operable to adjust the operation of the first and second wheels so that the mower can track a desired path, the biasing switch sending signals to the microprocessor in response to operation of the biasing switch that the microprocessor uses to control the operation of the first and second wheels.

56. The mower of claim 31, further comprising:

a mode switch, the mode switch being selectively operable between a work position and a transport position to adjust the operation of the first and second wheels, the work position corresponding to normal operation of the mower and the transport position corresponding to high speed operation of the mower, and the mode switch sending a signal to the microprocessor that the microprocessor uses to control the operation of the first and second wheels; and

the microprocessor operating the mower in a normal mode when the mode switch is in the work position and reducing a rate at which the at least two wheels steer the mower when the mode switch is in the transport mode so that the mower can safely turn during high speed operation.

57. The mower of claim 31, further comprising:

a gain controller that is selectively operable, the gain controller allowing a user of the mower to adjust the response of the mower caused by operation of the at least one controller, and operation of the gain controller causing the gain controller to send signals to the microprocessor that inform the microprocessor on how to interpret signals from the at least one controller; and

the microprocessor adjusts the operation of the first and second wheels in response to signals received by the microprocessor from the at least one controller based upon signals received from the gain controller.

58. A drive-by-wire dual path hydraulically driven riding lawn mower, the mower comprising:

first and second hydraulic pumps, the first and second hydraulic pumps providing respective first and second flows of hydraulic fluid;

first and second hydraulically driven wheels that operate independently and are capable of bi-directional rotation, the first and second wheels being independently rotated by the respective first and second flows of hydraulic fluid, and the independent rotation of the first and second wheels propelling and steering the mower;

first and second proportional servo valves, the first and second valves controlling a direction and volume of flow of the respective first and second flows of hydraulic fluid in response to signals received by the valves, the controlling of the direction and volume of flow of the first and second flows of hydraulic fluid controlling a direction and speed of rotation of the respective first and second wheels;

a microprocessor, the microprocessor controlling the operation of the first and second wheels by sending signals to the valves in response to signals received by the microprocessor, the signals sent by the mircroprocessor to the valves instruct the valves on how to control the first and second flows of hydraulic fluid to the respective first and second wheels; and

at least one controller, the at least one controller sending signals to the microprocessor that the microprocessor uses to control the operation of the first

and second wheels so that operation of the at least one controller causes the first and second wheels to propel and steer the mower.

Add B16